

Mea Culpa? No.

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This commentary, which appears in the Technical Discussion section of the September, 2006 issue of *Technological Forecasting & Social Change*, refers to a controversy over a supposed decline of science and technology in invention.

My brief note on Jonathan Huebner's article ("A Possible Declining Trend for Worldwide Innovation" *TFSC* vol. 72, no. 8) appeared in a journal of an association of research managers and directors (*Research · Technology Management* Nov-Dec, 2005; [download](#) the pdf)

Since I assumed they would soon hear about Huebner's paper, they needed an alert to its weaknesses. Huebner turned down the editor's invitation to write a reply. His later reply, in *TFSC*, makes out that I have hit a grand slam in that every point I made was wrong. However, I try to keep my error rate on minor things below 5%, and for big things below point five tenths of a percent. Hence this response to Huebner's rejoinder.

Huebner's source is *The History of Science and Technology* by Bryan Bunch with Alexander Helleman. That book could find a happy home in any family with growing children or a diffuse interest in science and technology. But it is not the right source for Huebner's project. As the dust jacket notes, it is "A Browser's Guide. . . ." It is like a gigantic *Readers Digest*, with many brief articles and zillions of fun factoids and engaging fillers. A far better starting place for Huebner would have been the *Oxford Companion to the History of Modern Science*, edited by H.L. Heilbron (2003), which includes a better source of references to follow up with.

In ancient times, 20-25 years ago, there was a widely accepted distinction between discovery and invention. In the constant search for pizzazz, the term "innovation" has come into use recently as an umbrella term for everything new scientifically or technologically. The ancient meaning of innovation was the adoption of something new.

So, the PC is invented once but adopted millions of times as an innovation. Huebner slips in the muddiness of the definitions he uses. To illustrate this, I randomly picked five left hand pages where my finger fell—pages 472, 496, 642, 246, and 384. I divided the 85 items discussed on those pages into three groups—*Inventions*, 37; *Discoveries*, 31; and *Miscellaneous*, 17 (a number of which were developments in mathematics). I have no idea which of these three sets made it into Huebner's pool.

This is important because it is the discoveries that lead to the technologies in the contemporary world, and it is the technologies that deliver the benefits. As a historic point, up to about 1880 technologies were invented and then engaged the interest of scientists. Gradually that reversed. Since World War II science has been increasingly responsible for spawning most new technologies. The implication for the contemporary period and even earlier is that the data in Huebner's tallying may just be a mix of incompatible cats and dogs.

Put differently, accepting his arithmetic, he has not established whether it is technology or scientific discoveries that are in decline, nor the relative extent of either decline. A comparison of Bunch's and Heilbron's books would highlight even for Huebner the value of many instead of one decider of importance. One book is headed for the mass market, the other for deliberative scholars. As a minor but telling point, the Bunch book notes the invention of can openers in three places in the book. Fun stuff and good ice breakers, but...

Huebner claims in his note on my remarks that if he did the analyses of different bins he "will" get the same result. I wonder how he knows that. It sounds like a premonition. He further claims that "...combining all innovations together is just as valid as sorting them into

different bins.” It is not clear what he means by “valid” but it is clear to me that valid is not the same as useful, which is what I assume Huebner is aiming at.

Patents are an unreliable measure of invention for several reasons. First, trade secrets are a reasonable alternative in situations where the patent would reveal useful information to an unscrupulous competitor, e.g., China or Korea. Second, the cost has gone through the roof for filing for patents. Third, the new widening to include intellectual property and life materials-will confuse historical comparisons. Fourth, it is unclear which and what percentage of patents are ever used, since some patents have at least in the past been used to muddy the ownership rights to products and processes, in order to force cross licensing.

Huebner, in defending his arithmetic, seems to like to go to extreme limits (in the mathematical meaning) to show that a mid-range criticism is unsound. That won't work with me or Modis. As the latter points out, there is no evidence that innovation (the way Huebner uses it) correlates with population size. Hence, as I see it, introducing global population into the determination of innovation rates is unsound or at least unproven, and therefore gratuitously makes the historic trend exaggerated and alarming. Huebner's insistence on making global population his denominator ignores what most of us know, that scientific discoveries and the invention of new technologies require in the modern world an educated population and an appropriate social infrastructure. They do not exist for all practical purposes in Africa, most of South America, Indonesia, the Indo-Chinese peninsular, most of Southeast Asia, North Korea, Mongolia, the Asian Islamic countries, and almost all of the former Soviet Union. Please get them out of the denominator.

In summary, Huebner's analysis uses questionable data, inadequately categorized, and analyzed on an inappropriate geographic scale. Nevertheless the work cries out to be repeated while attending to the defects noted.